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The Spruce Beetle

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The spruce beetle, *Dendroctonus rufipennis* (Kirby),[3] annually kills 333-500 million board feet of spruce sawtimber. Outbreaks of this beetle have caused extensive mortality in Alaska, Canada, Colorado, Montana, and New England. During the most prominent outbreak, which occurred in Colorado from 1939-51, the beetle killed an estimated 3.8 billion board feet of Engelman spruce. More recently, a 1961–65 outbreak in British Columbia killed over 3 billion board feet of spruce.

Overmature trees are usually attacked first, but trees in all diameter classes may be killed. The size and age of individual standing trees are the only obvious characteristics that indicate susceptibility. If an infestation persists in an area, beetles will infest smaller diameter trees as the larger trees in the stand are killed.

The beetle generally prefers downed timber, and is usually present in low numbers in windthrown or weakened trees. When populations increase to a high level, the beetles may enter standing timber. Most of the outbreaks in standing timber have originated in blowdowns, although logging residuals —especially cull logs—may be a contributing factor. In logging areas, the beetle may be found in cull logs, tops, and stumps. The adult beetles prefer the lower surfaces of the logs and tops.

In the Rocky Mountain area, susceptibility of standing spruce timber decreases in the following order: (1) trees in creek bottoms, (2) better stands on benches and high ridges, (3) poorer stands on

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[3] In 1963, Wood synonomized several species of spruce-inhabiting *Dendroctonus* beetles and thus created one species, *D. obesus* (Mannerheim), with a widespread distribution. In 1969, Wood corrected an oversight in his 1963 revision and presented *D. rufipennis* (Kirby) as the correct name for the spruce beetle.

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benches and high ridges, (4) mixtures of spruce and other species, (5) stands of immature trees.

Host Trees

The beetle attacks all species of spruce within its range (fig. 1).

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Figure 1.—Probable geographical distribution of spruce beetle. Redrawn from Wood (1963) with his permission.

The more important commercial species affected include: Engelmann spruce, Sitka spruce, and white spruce.

Description

The adult is a dark brown to black beetle with reddish-brown wing covers. Older adults are usually entirely black. The beetles are cylindrically shaped, approximately 4-7 mm. long and 3 mm. wide (fig. 2). The eggs are oblong, pearly white, and 1-2 mm. long. The larvae are stout, cylindrical, legless grubs that pass through several instars and attain a length of 6 mm. at maturity. The pupae are creamy white and similar in size to the adult.

Evidence of Attack

The needles of infested trees usually turn a yellowish green and fall about 1 year after attack, but they may remain green until the second year. The needles do not turn a reddish color as do those on beetle-infested pines. The recently killed trees have a yellowish orange to reddish hue after needle drop due to the color of the exposed twigs; this color is especially noticeable in the upper 1/3 of the crown. Dust-clogged entrance holes and lesser numbers of unclogged holes may be visible in the bark. Occasionally, masses of pitch may accumulate around the entrance holes; often these pitch masses indicate unsuccessful attack. Red boring dust from the entrance holes usually accumulates in bark crevices around the bases of the infested trees.

Life Cycle

In the Northeast and coastal areas of the Northwest, the spruce beetle generally has a 1-year life cycle. The adults emerge during June through August and attack host material soon after emergence; some attacks may continue until October. The eggs hatch and the beetles overwinter in the larval stage. The larvae resume development in May, transforming to pupae and then adults in June.

The life cycle of the beetle in the Rocky Mountains generally takes 2 years. Beetles may complete development in 1 year on warm sites at lower elevations, or take as long as 3 years in cool, well-shaded locations on north slopes. In the 2-year life cycle, the adults may emerge from May through July and attack host material soon after emergence. Adults may also emerge and attack from August to October, but this may represent reemergence of parent adults or movement of maturing brood adults to hibernation sites. After the females bore through the bark, they create egg galleries in the phloem that are usually parallel with the bole of the tree and slightly groove the xylem (fig. 3). The egg galleries are slightly wider than the beetle and packed with frass and boring dust except for the terminal portion. Egg galleries may range from about 6 cm. to 30 cm. long, but average about 13 cm. The eggs are usually deposited in short rows along alternate sides of the galleries. Average number of eggs per cm. of gallery varies from 4 to 14.

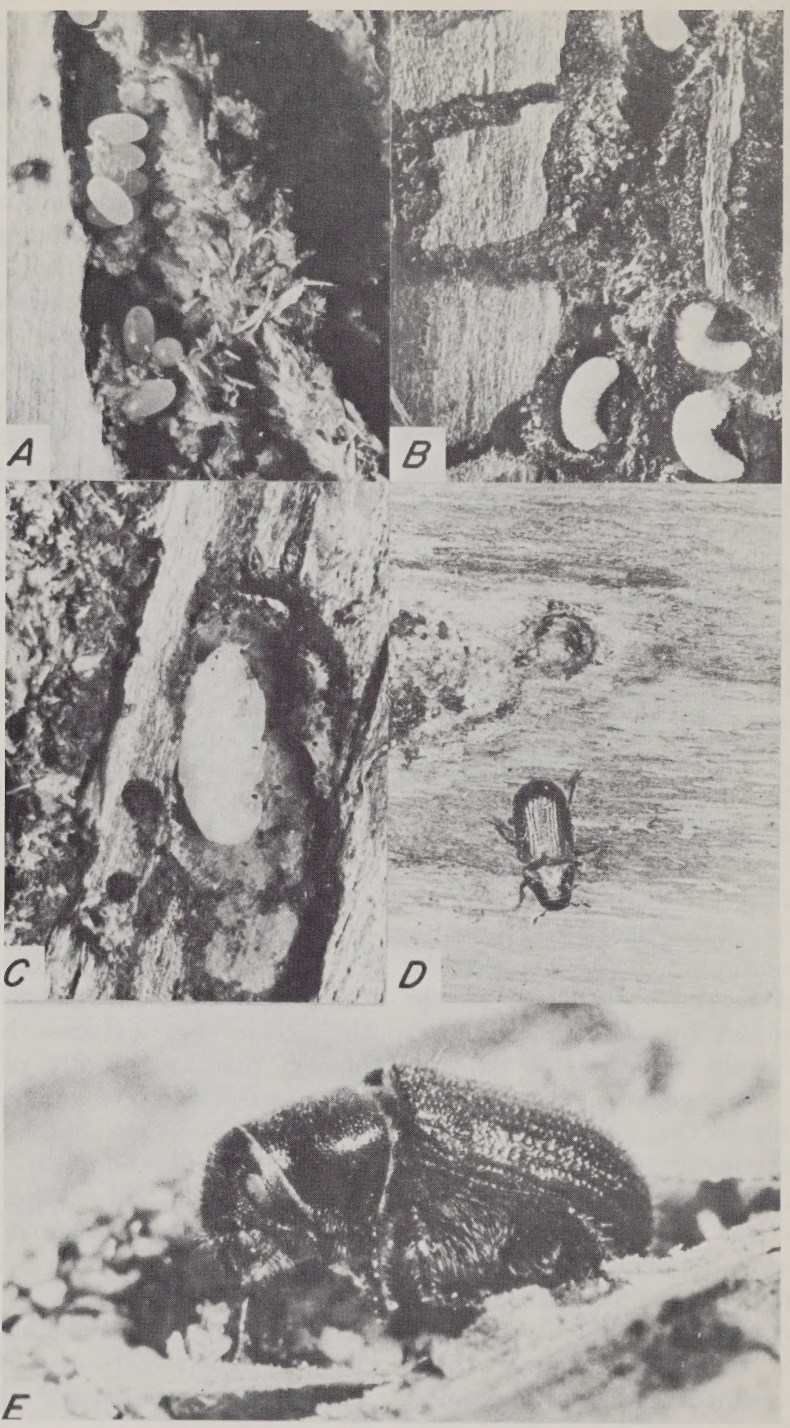

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Figure 2.—Spruce beetle: *A*, Eggs; *B*, larvae; *C*, pupa; *D*, adult (top view); *E*, adult (side view).

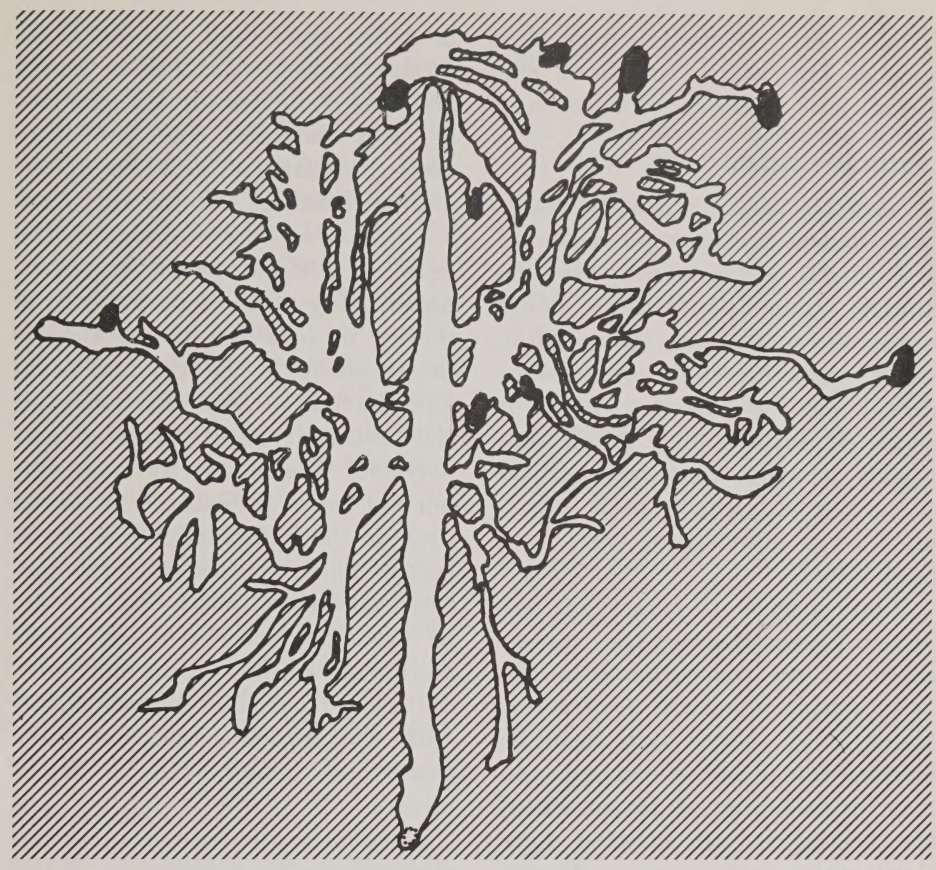

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Figure 3.—Spruce beetle egg gallery with larval mines developing outward. Larvae usually obliterate phloem between the individual galleries during the first instars. Later the larval galleries become more separated but frequently cross one another. Darkened areas indicate pupal sites, unconsumed phloem is represented by cross hatched area, while the broken circle indicates the entrance hole in the egg gallery.

Most of the eggs have hatched by August, although eggs may be found in September-October. The larvae mine outward from the egg gallery, feeding as a group. As they mature, the larvae construct individual feeding galleries. The larval stage predominates during the first overwintering period, although parent adults and eggs may also be present. Most of the larvae pupate in 10 to 15 days in summer (approximately 1 year after attack) in chambers at the end of the larval galleries.

Adult beetles may overwinter in their pupal sites or in the bases of the infested trees. In standing timber, anywhere from 5 to 88 percent of the adults may emerge, move to the base of the tree, and bore into the tree near the litter line to hibernate. In downed material, most adults overwinter in place. The following spring (approximately 2 years after attack), adults

from both overwintering sites emerge and attack new host material.

Natural Control

Natural factors normally maintain spruce beetle populations at low levels, but generally fail to control these populations under outbreak conditions. They often cause high mortality in specific areas, such as infested trees or localized infestations. When outbreaks develop, however, natural factors usually have little effect, until large numbers of trees have been killed.

Four species of nematodes are internal parasites in the various stages of the spruce beetle in the West. *Sphaerulariopsis dendroctoni* Massey may reduce oviposition of infested females by 70 percent, and may infest as high as 75 percent of the beetles in an infested tree. *Contortylenchus reversus* Thorne parasitizes the larvae, pupae, and adults, and may reduce oviposition of infested females by 45 percent. Effects of other internal and external parasitic nematodes associated with the spruce beetle are unknown.

The Northern three-toed, hairy, and downy woodpeckers are important predators of the spruce beetle in the Rockies. During outbreaks in standing timber, woodpeckers may consume 45 to 98 percent of the beetle brood. During low levels of infestations, woodpeckers may account for 25 to 50 percent of the beetle mortality in standing timber. They may consume up to 79 percent of the population in fallen trees, and can work effectively even when fallen trunks are only 6 inches off the ground.

Insect parasites and predators destroy substantial numbers of immature beetles. A braconid, *Coeloides dendroctoni* Cushman, is the most important parasitic insect, parasitizing up to 60 percent of the beetles in localized areas. It oviposits through the thinner bark, and the larvae feed externally on the beetle larvae. A fly, *Medetera aldrichii* Wheeler, is the most important insect predator. The larvae prey on the immature stages of the beetle. Three species of clerid beetles feed on the spruce beetle; clerid larvae prey on beetle larvae and adults on adults. Additional predators and parasites are associated with the spruce beetle, but their importance remains to be determined.

Extremely low temperatures can eliminate beetle infestations if the beetles have not developed a cold-hardiness. Temperatures of −15°F. under the bark will kill nearly all adults, while −30°F. will kill the larvae.

Excessive moisture may promote the growth of fungi in the phloem so that it becomes unsuitable for beetle development. Loss of moisture through openings created by woodpeckers may cause the phloem to become too dry for the immature beetles.

Applied Control

Clearcutting in irregular patches with disposal of cull logs appears to be the most promising method of reducing potential spruce beetle

problems. Any method that removes overmature trees and promotes vigorous growth of the immature trees is desirable. Clearcut salvage operations have also been used to control infestations that have already developed.

"Trap trees," intentionally felled prior to beetle flight, are highly attractive and often provide an effective way of concentrating and trapping spruce beetles. After the beetles have entered the downed logs, the logs are usually salvaged but may also be treated chemically or removed and burned.

If chemical control is necessary, contact your regional USDA Forest Service or State Forest Service pest control office for information on recommended chemicals, formulations, rate of application, and method of treatment.

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